tail-fin became shorter still. It is not without interest to find the extremity of the tail presenting so little variation in essentials of structure, as the order of animals is traced through the secondary strata.

LXIX.—*On the Interlocking of the Neural Arches in Ichthyosauria.* By H. G. Seeley, F.R.S., F.G.S., King's College, London.

The neural arches in Ichthyosaurs are never closely united with the centrums. When the centrums are isolated the arches are commonly lost. The characteristics of the arch are imperfectly known. They are illustrated by Cuvier in plate cclvi. Oss. Foss., but the figures are indefinite as to the interlocking of the arches, though the text indicates that Cuvier had seen and knew the structural relations of the bones. The excellent preservation of the vertebral column, with the vertebræ in natural sequence in skeletons imbedded in Lias slabs in the museums of this country and the Continent, is unfavourable to demonstration of the mutual relations of the neural arches. Exposed in side view they have a general resemblance to those of porpoises, for there is a manifest contact between them above the region of the neural canal by surfaces which enable the arches to support each other. But in *Ichthyosaurus* this zygapophysial surface does not project laterally, so that the lateral aspect of a neural arch is smooth and slightly concave from above downward, or only slightly tumid in the zygapophysial area. I have never seen any trace of laterally developed zygapophyses except in the cervical region.

It would appear that the cervical vertebræ is the part of the column most easily observed. Sir Richard Owen, in his 'Report on British Fossil Reptiles,' 1839, p. 100, speaking generally, states that "the neurapophyses are interlocked together by means of coadapted oblique processes." This is true for the neck, but not for the later vertebræ. In the account of *Ichthyosaurus platyodon* it is remarked in the same memoir: "the articular processes for mutual interlocking are well developed, especially at the anterior part of the spine." Forty-two years later lateral zygapophysial facets in *Ichthyosaurus* were figured by Owen in the Palæontographical

Society's Monograph, 1881, pl. xxi. In 1891 Dr. Eberhard Fraas figured two prezygapophyses in his memoir on Lias Ichthyosaurs (pl. iii. fig. 6).

In 1869 ('Index to Aves, Ornithosauria, and Reptilia,' p. 111), in describing *Ichthyosaurus megalodeirus* from the Oxford Clay, I found the neural arches preserved in the sixth and seventh cervicals, and displaced laterally, so as to show the lateral zygapophyses, which are "long and oblique, looking upward and inward"; but I am unable to affirm that this characteristic prevailed in all the twenty-six cervical vertebræ, though the unusual length of the neck, permitting lateral movement, makes such a condition probable.

Examination of the skeletons from the Lias has shown that the antero-posterior articular union between adjacent neural arches is made by a single flat median facet, vertically ovate, inclined at an angle of 45° in the dorsal and caudal regions. The facet varies a little in proportion of length to width. It is always immediately above the neural canal. In some anterior examples the facet is indented by the neural canal beneath it, so that it acquires a horseshoe type of form. In such specimens the neural spine is short and depressed and the neural arch is small. Professor Eb. Fraas, in tab. v. fig. 11 'Ichthyosauria,' 1891, represents a single vertically ovate facet with an appearance of vertical division, in the neural arch of an Ichthyosaur.

In January 1889 Mr. A. N. Leeds, F.G.S., obtained and submitted to me the first known British example of an isolated neural arch from the Oxford Clay of Fletton, which since then has been referred to in my lectures as *Ophthalmosaurus icenicus* (figs. 1 & 2).

The specimen measures 4½ inches from the neuro-central suture to summit of the neural spine. The neurapophyses are compressed from side to side, half an inch wide in front, where the neural interspace between them is eight-tenths of an inch wide. The processes are more compressed from side to side posteriorly. The neuro-central sutural border is convex from front to back (fig. 1). In axial aspect the processes converge upward to arch over the neural canal, which appears to have been triangular and rather higher than wide (fig. 2). In lateral aspect the processes are concave on both the front and back borders, to define the interspaces for the escape of the intervertebral nerves (fig. 1).

Above the neural canal is the single facet by which the

arches rest upon each other and interlock. The prezygapophysis is $1\frac{2}{10}$ inch deep and $\frac{4}{10}$ inch wide, flat, vertically ovate, and not appreciably raised above the level of the oblique zygapophysial surface, which extends backward above the neural canal, to the base of the neural spine. It is about $\frac{9}{10}$ inch above the neuro-central suture (fig. 2, A). The

Fig. 1. Fig. 2.

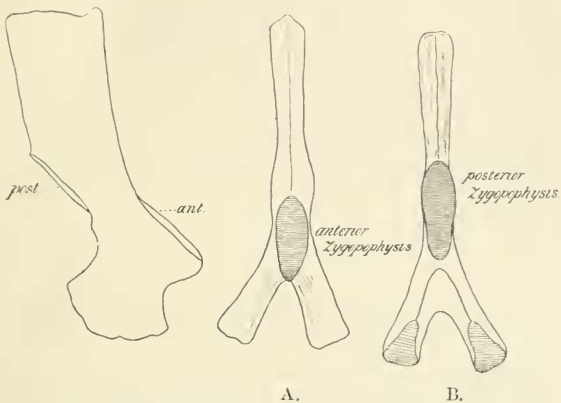

Fig. 1.—Lateral aspect of the neural arch in *Ophthalmosaurus*.
Fig. 2.—*Ophthalmosaurus icenicus*: neural arch. A, anterior; B, posterior. Half natural size.

corresponding posterior zygapophysial facet is parallel and entirely behind the anterior facet (fig. 1), but the vertical distance between the back of one and the front of the other is about $\frac{6}{10}$ inch. This posterior facet is a little longer and a little wider (fig. 2, B), giving a slight bulge to the posterior border of the neural spine at the articulation (fig. 2, A).

The neural spine is compressed from side to side, three to four tenths of an inch thick above these articular facets, and becoming a little thicker towards the free end. It is limited back and front by a sharp ridge. The antero-posterior measurement between these borders is $1\frac{2}{10}$ inch above the postzygapophysis, to $1\frac{3}{10}$ at the free termination. The

terminal surface is rough and irregular and appears to have been cartilaginous.

The structure here described I believe to be the typical Ichthyosaurian mode of articulation of the neural arch in vertebræ behind the neck, about as characteristic as is the presence of zygosphene and zygantrum in the neural arch of an Ophidian. It is not quite unique, being also met with in the neural arches of the caudal vertebræ of certain Plesiosaurs from the Kimeridge Clay, much as the Ophidian type of neural arch is met with in certain Lacertilia.

The physiological interest of the single zygapophysial facet is the evidence it affords as to the absence of lateral motion of the body, as indicated by absence of resistance to movement of the arches upon each other. The greater length of the postzygapophysis may show a small vertical gliding movement of the prezygapophysis against it, which would be consistent with a vertical movement of the tail, a diving habit, and a folding of the tail beneath the body in swimming.

LXX.—*Brachiopod Nomenclature: The* Terebratulæ *of the Crag.* By S. S. Buckman, F.G.S.

The English Tertiary deposits known as the Coralline Crag and the Red Crag are famous for yielding *Terebratulæ*, some of which attain very large dimensions. For many years, on the authority of Davidson, these Crag *Terebratulæ* have been regarded as one species, and have been identified with the Hanoverian *Terebratula grandis*, Blumenbach.

During some recent curatorial work, having occasion to examine these Crag *Terebratulæ* for the purpose of their exhibition, I came to the conclusion that the identification of any of them with *T. grandis* could not be sustained. Further, the material examined showed that there were at least four fairly distinct forms, which could be distinguished as follows:—

1. A large oval form.
2. A large elliptical form.
3. A medium-sized, narrow, elliptical form.
4. Small, aged forms, which are dwarfs.

Thus there are three forms which differ considerably in shape and one series of dwarfs, many of which are not the